L Number	Hits	Search Text	DB	Time stamp
1	52	multilayer adj3 metal adj3 foil and (forming or manufacturing or making)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM TDB	2001/08/30 10:17
2	6	(multilayer adj3 metal adj3 foil).ti. and (embossed or corrugated)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM TDB	2001/08/30 10:20
3	230	(metal adj3 foil).ti. and (embossed or corrugated)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM TDB	2001/08/30 10:30
4	110	((metal adj3 foil).ti. and (embossed or corrugated)) and (multilayer or layers)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM TDB	2001/08/30 10:21
5	11	(metal adj3 foil).ti. and (zigzag or z-fold adj pack)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM TDB	2001/08/30 10:34
6	255	(metal adj3 foil).ti. and (pack or folds)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM TDB	2001/08/30 10:47
7	749	(metal adj3 foil).ti. and (roll or roller or spool)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM TDB	2001/08/30 10:48
8	12	((metal adj3 foil).ti. and (roll or roller or spool)) and stack	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM TDB	2001/08/30 10:49
9	36	((metal adj3 foil).ti. and (roll or roller or spool)) and (emboss$4 or scor$4 or corrigat$4)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM TDB	2001/08/30 10:55
10	35	(("4530230") or ("2879587") or ("2729445") or ("2434558") or ("2411075") or ("2333936") or ("2277725") or ("1497296") or ("3844878") or ("5928767")).PN.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM TDB	2001/08/30 10:56
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12	0	1497296.URPN.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM TDB	2001/08/30 10:58
13	3	2411075.URPN.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM TDB	2001/08/30 10:59
14	4	2729445.URPN.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM TDB	2001/08/30 10:59

United States Patent [19]

Shaw

[11] **4,348,450**

[45] **Sep. 7, 1982**

[54] **INSULATING AND PACKAGING MATERIAL OF METAL FOIL-NONWOVEN GLASS FABRIC**

[76] Inventor: **Julius Shaw**, 259 Field St., Bedford, Mass. 02740

[21] Appl. No.: **340,116**

[22] Filed: **Jan. 18, 1982**

Related U.S. Application Data

[60] Continuation-in-part of Ser. No. 178,794, Aug. 18, 1980, Pat. No. 4,312,909, which is a division of Ser. No. 32,286, Apr. 23, 1979, Pat. No. 4,242,165.

[51] **Int. Cl.**³ **B32B 17/10**

[52] **U.S. Cl.** **428/182**; 156/242; 156/301; 156/302; 156/313; 156/324; 156/332; 428/215; 428/285; 428/286; 428/441; 428/461; 428/537

[58] **Field of Search** 428/182, 215, 285, 286, 428/441, 461, 537; 156/242, 272, 301, 302, 307, 313, 324, 332

[56] **References Cited**

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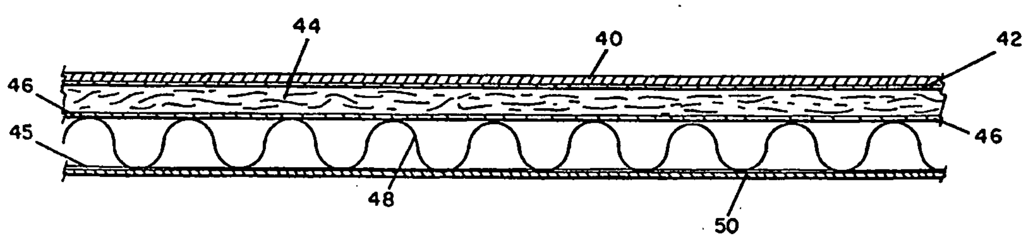
Primary Examiner—Marion McCamish
Attorney, Agent, or Firm—William Nitkin

[57] **ABSTRACT**

A laminated insulating and packaging material comprised of a metal foil sheet bonded to a non-woven glass fiber paper-like sheet by a latex adhesive which resulting laminate in certain embodiments is bonded to corrugated cardboard to make fire-retardant packaging material.

4 Claims, 3 Drawing Figures



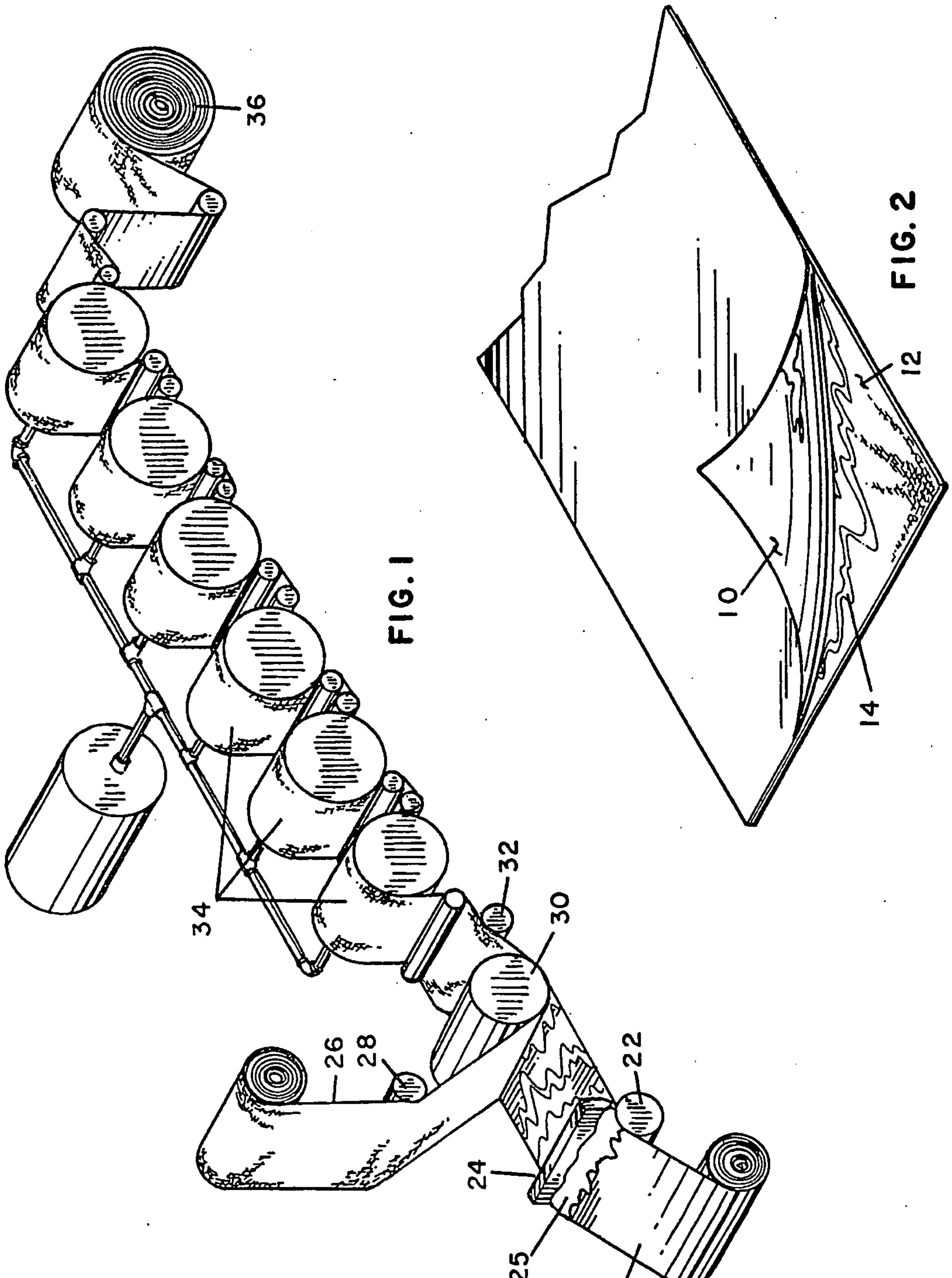


FIG. 1

FIG. 2

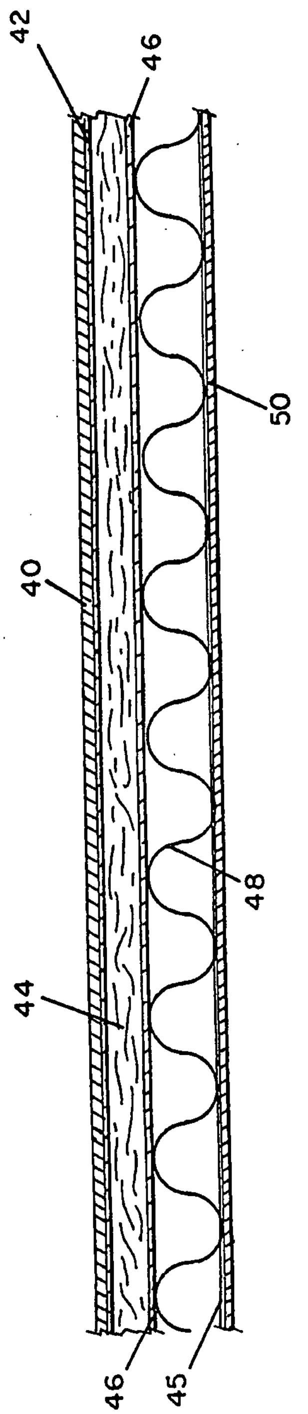


FIG. 3

INSULATING AND PACKAGING MATERIAL OF METAL FOIL-NONWOVEN GLASS FABRIC

This application is a continuation-in-part of my application for Insulating Material of metal film bonded to non-woven glass fabric with ethylene/vinyl acetate copolymer adhesive, Ser. No. 178,794 filed Aug. 18, 1980, U.S. Pat. No. 4,312,909 which application is a division of application Ser. No. 032,286 filed Apr. 23, 1979 for Insulating Material and Process for Manufacturing Same by Julius Shaw., U.S. Pat. No. 4,242,165.

BACKGROUND OF THE INVENTION

Field of the Invention

The product and process disclosed herein reside in the field of insulating and packaging materials and processes for making same and more particularly relate to an improved, relatively thin material utilized for insulation especially in construction of electrical and/or heat-producing devices.

Materials for heat insulation in the construction of electrical and/or heat-producing devices such as light fixtures have long been utilized. In the past they have often taken the form of non-combustible materials bonded to a backing, for example, asbestos fibers bonded to a metal foil. The advantage of asbestos is that it has high temperature and flame resistance. Unfortunately asbestos has been found to be a carcinogen and is no longer a favored material for the manufacture of such relatively thin insulating materials. Currently in use is ceramic paper, but this material is extremely expensive and its widespread use is thereby limited.

SUMMARY

It is an object of the present invention to provide an improved, relatively thin material in laminate form and a process for producing same that can be utilized for insulating purposes and have light and heat reflecting properties.

It is a further object that the material of the present invention can be supplied in sheets, rolls or pieces cut to a desired shape.

It is another object of this invention to provide a fire and heat resistant material which will neither rot nor corrode, will have flexibility to conform to the areas of its use and yet not have any harmful characteristics.

It is a further object of the present invention to provide a low-density insulating material that is both dimensionally stable and lightweight and which can be utilized in a variety of areas such as electric lighting fixtures, electronic equipment, and the like. It is a further object to provide an improved fire-retardant packaging material especially useful for packaging chemicals.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a segment of the laminate of this invention.

FIG. 2 is a perspective view of the apparatus for manufacturing the laminate of this invention.

FIG. 3 is a cross-sectional view of the packaging material laminate.

DESCRIPTION OF THE PREFERRED EMBODIMENT(S)

The insulating material of this invention seen in FIG. 1 is a laminate comprised of a metal foil 10 bonded to a

non-woven glass fiber paper-like material 12. The metal foil of this invention which can be aluminum foil or other equivalent metal foils, can be provided in a thickness of 0.0007 in. to 0.005 in. The non-woven glass fiber paper-like material can be provided in the range of 0.010 in. to 0.500 in. The laminate of this invention has a wide range of uses utilizing such glass fiber paper-like material in a thickness of 0.015 in. which is bonded to a 0.001 in. aluminum foil. A plasticized ethylene vinyl acetate co-polymenr emulsion or equivalent latex acrylic is used as an adhesive to bind the metal foil to the glass fiber paper-like material. One such adhesive is supplied by American Finish and Chemical Co. of Chelsea, Mass. and has a product number of SRD870. Equivalent adhesive materials can include vinyl acetate homo-polymers which make use of plasticizers to soften the film formed to improve flexibility of the laminate such as phthalate esters, phthalyl glycolates or phosphate esters. In the process of manufacturing the insulating laminate of this invention, one can utilize rolls of metal foil such as aluminum foil and rolls of a non-woven glass fiber paper-like material, the rolls being of substantially equal width. In FIG. 2 aluminum foil web 20 is passed over a resilient rubber roller 22 above which is disposed a knife 24. Positioned before knife 24 is adhesive 25 resting upon foil web 20 which passes under knife 24. Knife 24 is disposed above roller 22 and web 20 approximately 3.5 mils so as to allow some adhesive 25 to be carried on web 20 under knife 24. Rubber roller 22 helps to allow for any unevenness in the web to protect knife 24. The adhesive can be mechanically applied before the knife or can be ladled into position. As the web of foil passes thereunder, the adhesive forms a film thereon. It has been found that a knife height of 3.5 mm. cited above avoids the formation of any bubbles or bare spots upon the foil web and provides for an even dispersement thereon of the adhesive. If too much adhesive is used, it is wasteful and also can affect the flexibility of the laminate. Disposed above the foil web is a roll containing the glass fiber paper-like web in the thickness and dimensions cited above. The glass fiber paper-like web is passed under an expander roller 28 to remove wrinkles and then under a marriage roller 30 which it mates with foil web 20 and the laminate thus formed passes over an idler roller 32. The glass fiber paper-like web 26 and foil web 20 are further compressed together with the adhesive forming a bond therebetween, the adhesive being forced from the bottom web into the interstices of the glass fiber paper-like material. The laminate is passed over a series, preferably six, of can rollers 34, each composed of stainless steel heated usually by steam to a temperature range of 225° F.-240° F. which heat treatment cures the adhesive for a more permanent bond. It has been found that if the laminate dries without sufficient heat, over a period of time the polymers in the adhesive will not properly bond and the laminate will separate. The laminate upon exiting from the last can roller 34 is then rolled upon a take-up reel 36. The glass fiber paper-like material may be somewhat thicker before lamination as there is a certain amount of compression which takes place in the process of this invention. The laminate material after curing can then be utilized.

The laminated rolls are usually spread out into sheets for large applications or can be die cut into discrete shapes for particular uses in electrical apparatuses. Underwriters Laboratory has approved the use of the lami-

nate of this invention insofar as there is no danger of fire. It has been found that the laminate of this invention can be used successfully with temperatures up to 600° F. and the metal foil provides good reflectance of both light and infrared rays in applications where such properties are desirable.

FIG. 3 illustrates an embodiment wherein the above described laminate is bonded to a Kraft paper of 30–90 lbs by the same methods as described above and this resulting laminate is bonded to an A, B, C or D single or double-wall corrugated cardboard. The resulting material can be manufactured into fire-retardant containers for all kinds of products but is especially useful for chemicals. Seen in this view is foil 40 bonded by adhesive 42 to glass fiber 44 which is bonded to Kraft paper 46. This resulting laminate is then bonded to the corrugated cardboard by the same bonding techniques as described above. The corrugated layer 48 of the corrugated cardboard is bonded to the outside layer 50 by adhesive 45 by standard methods used in the industry to produce corrugated cardboard.

Although the present invention has been described with reference to particular embodiments, it will be apparent to those skilled in the art that variations and modifications can be substituted therefor without departing from the principles and spirit of the invention.

I claim:

1. A laminate for use in insulation of electrical apparatuses comprising:
   - a metal foil sheet such as aluminum foil, having a thickness of between 0.0007 in. and 0.005 in.;
   - a non-woven glass fiber paper-like sheet having a thickness of between 0.010–0.500 in.; and
   - a plasticized ethylene vinyl acetate co-polymer emulsion-type adhesive bonding said metal foil sheet to said non-woven glass fiber paper-like sheet.

2. An insulating device comprising a discrete section of material comprised of a metal foil of 0.0007–0.005 in. adhesively secured by a latex acrylic adhesive such as a plasticized ethelene vinyl acetate co-polymer to a non-woven glass fiber paper-like sheet having a thickness in the range of 0.010–0.500 in.

3. A laminate for use as packaging material comprising:
   - a metal foil sheet such as aluminum foil, having a thickness of between 0.0007–0.005 in.;
   - a non-woven glass fiber paper-like sheet having a thickness of between 0.010–0.500 in.;
   - a sheet of Kraft paper of a weight between 30–90 lbs;
   - a sheet of corrugated cardboard of either single or double-wall type; and
   - a plasticized ethylene vinyl acetate co-polymer emulsion-type adhesive bonding said metal foil sheet to one side of said non-woven glass fiber paper-like sheet and one side of said sheet of Kraft paper to the other side of said glass fiber sheet and said corrugated cardboard to the other side of said Kraft paper.

4. A method of producing a fire-retardant packaging material comprising the steps of:
   - providing a metal foil sheet such as aluminum foil having a thickness of between 0.007–0.005 in.;
   - providing a non-woven glass fiber material having a thickness of between 0.010–0.500 in.;
   - providing a volume of latex acrylic adhesive;
   - bonding said metal foil to said non-woven glass fiber material with said adhesive;
   - providing a sheet of Kraft paper of between 30–90 lb. stock;
   - bonding said Kraft paper to said glass fiber material on the side opposite said metal foil with said adhesive;
   - providing a sheet of corrugated cardboard of either single or double-wall type; and
   - bonding said cardboard to said Kraft paper on the side opposite said glass fiber material.

* * * * *

United States Patent [19]

Ohlbach

[11] **Patent Number: 4,684,020**

[45] **Date of Patent: Aug. 4, 1987**

[54] **CONDUCTIVE CONTAINER**

[75] Inventor: **Ralph C. Ohlbach, Deerefield, Ill.**

[73] Assignee: **Conductive Container, Inc., Northbrook, Ill.**

[21] Appl. No.: **838,292**

[22] Filed: **Mar. 10, 1986**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 778,398, Sep. 20, 1985, abandoned.

[51] **Int. Cl.**[4] **B65D 73/02**

[52] **U.S. Cl.** **206/328**; 206/334

[58] **Field of Search** 206/328, 334, 592, 444, 206/312; 220/410, 118

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Primary Examiner—Joseph Man-Fu Moy
Attorney, Agent, or Firm—Kinzer, Plyer, Dorn & McEachran

[57] **ABSTRACT**

Conductive container for electronic devices, constructed of paperboard having a conductive coating or layer or impregnant extending from the inside to the outside of the container, with a sandwiched thin metal foil in effective contact with the conductive material.

12 Claims, 7 Drawing Figures

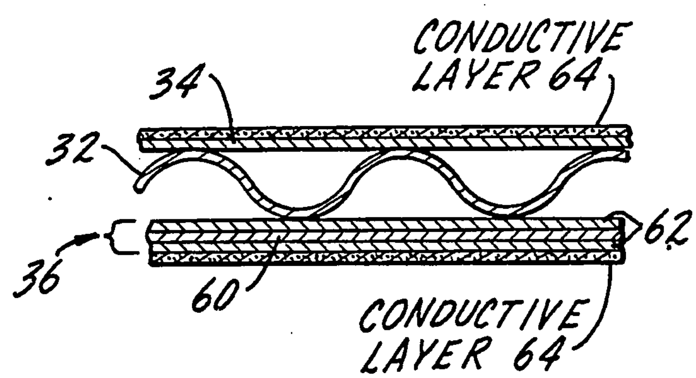


Fig. 1.

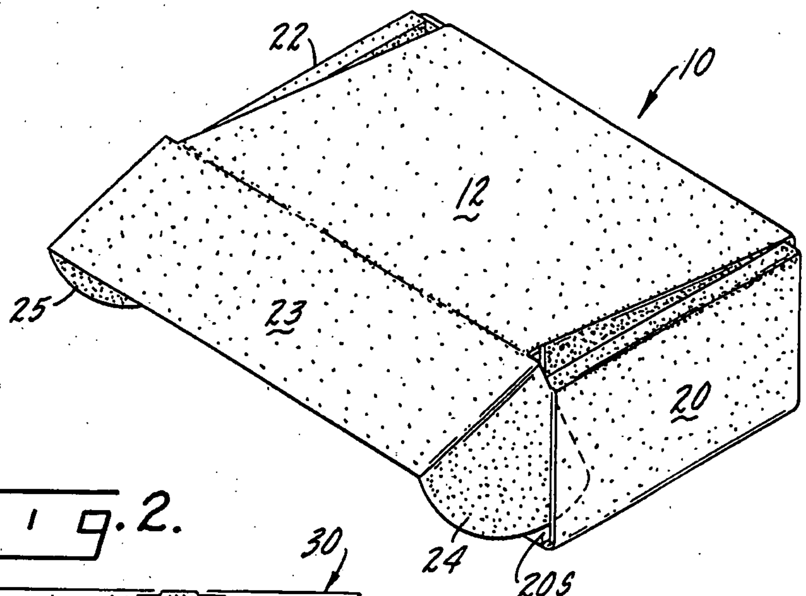
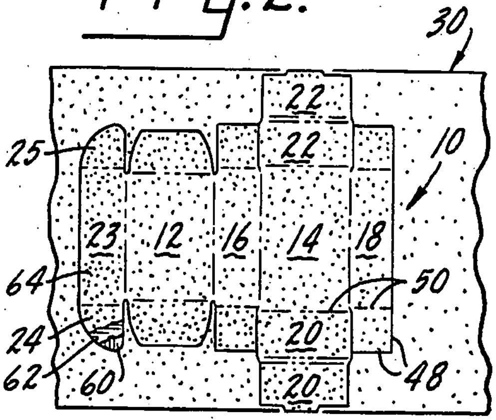


Fig. 2.



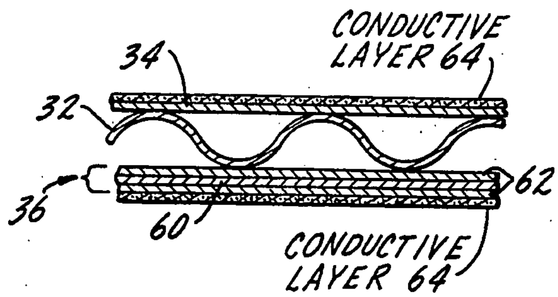


Fig. 4.

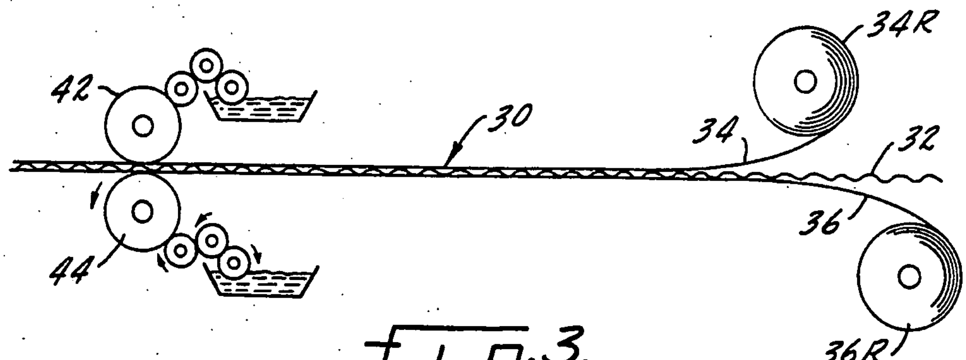


Fig. 3.

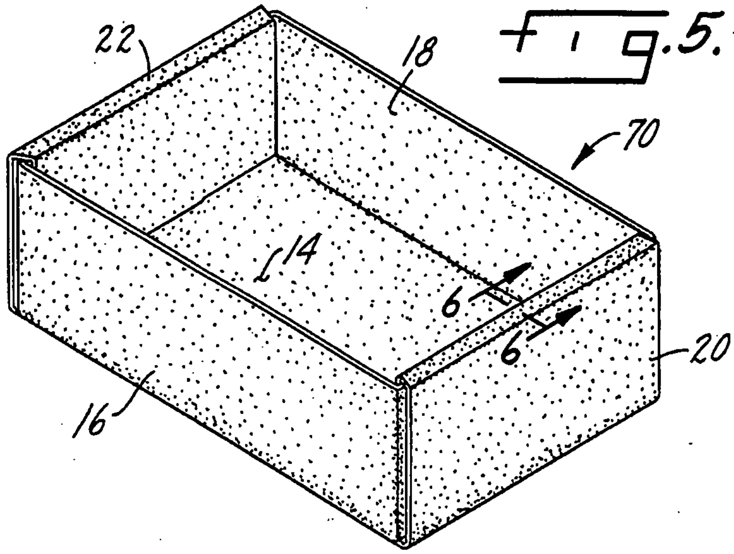


Fig.5.

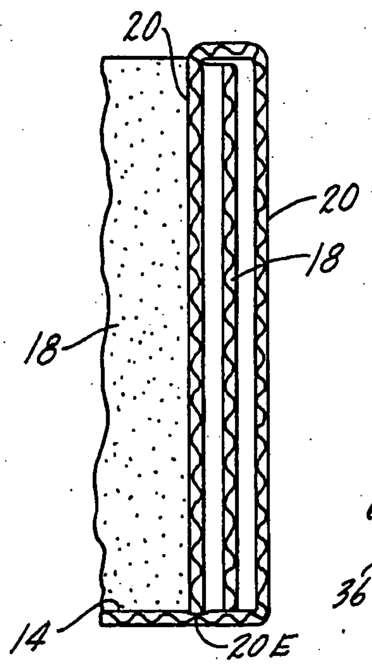


Fig.6.

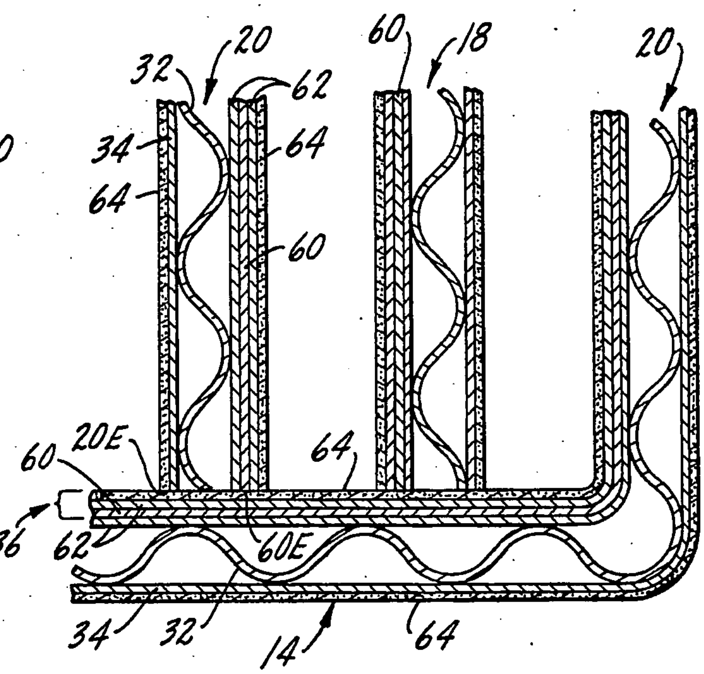


Fig.7.

CONDUCTIVE CONTAINER

This is a continuation-in-part of application Ser. No. 778,398 filed Sept. 20, 1985, now abandoned.

This invention relates to the protection of goods which can be damaged by a discharge of static electricity and by other electrical phenomenon to be explained, particularly fields due to electromagnetic and radio frequencies.

With the advent of microcircuitry and the use of integrated circuits incorporating metal oxide semiconductors, complimentary metal oxide semiconductors, field effect transistor silicone chips, related microcircuitry and electronics where threshold voltages or potentials may be five or ten volts or even less, the devices are hypersensitive to electrical current or emf values which cannot be avoided in every day life. Examples of such unavoidable interferences are small charges built up on a person's body as the result of mere movement across an insulated surface, electromagnetic waves and radio frequencies.

I have effectively coped with the electrostatic phenomenon under the disclosures according to my U.S. Pat. Nos. 4,160,503, 4,211,324 and 4,293,070. Practice under these patents has amounted to considerable commercial success and it can be safely stated that in many instances the cartons of those patents have been adopted as standard practice by some of the largest companies in the world.

Briefly stated, the disclosure in the Ohlbach patents listed in the foregoing paragraph are concerned with creating a carbon black circumvalate trap by which any electrostatic charge is trapped in the carbon black coating or layer and is either bled off to ground or circulates harmlessly until the charge decays to a harmless or meaningless value. However, the conductive carbon black is not necessarily an effective shield against electromagnetic and radio frequencies. The electronic devices inside the container (chips or microcircuitry) can also be damaged or rendered useless by a field of radio frequency or electromagnetic waves. In the industry these phenomena are termed emi (electromagnetic interference) and rfi (radio frequency interference). The interferring field alone, without any current flow, whether emi or rfi, can itself be the source of damage, known as electrical overstress. On the other hand, if the device is moved within the field, then by Kirchoff's law, a current is induced in the device which itself may be strong enough to damage or ruin the chip or the circuitry. Shielding an electronic device or the associated circuitry (herein both are referred to as the "device") to prevent interference from an electromagnetic or radio source is known: U.S. Pat. Nos. 2,766,920 and 2,899,050; also the article in the publication ITEM, 1983 entitled "Shielding—Coating Options in the Eighties." In brief, the device is surrounded by a thin metal foil (e.g. aluminum foil) and the metal foil by absorption of the field (capture) or mere reflection of the field or internal re-reflection (resonance) greatly reduced the chances of damage of the device due to electrical overstress or due to the creation of an unwanted current under Kirchoff's law. However, since the metal foil is a conductor, it itself is subject to Kirchoff's law, namely, that a conductor moving within a field will create a current; and if the foil is sandwiched between insulators, the phenomenon of a capacitor is created. In any event, the hazard is present, namely, a charge on the metal foil

itself and that charge can become the source of a spark or static discharge spike when the package is opened and the device is exposed.

It is an object of the present invention to effectively deal with the two interferences identified above (emi and rfi) in a container of the kind disclosed in my aforesaid patents; specifically it is an object of the present invention to assure that any induced current created on the shield may be drained or grounded.

IN THE DRAWING

FIG. 1 is a perspective view of a typical container constructed under the present invention and representing one embodiment;

FIG. 2 is a plan view of the development of a carton blank to construct the container shown in FIG. 1;

FIG. 3 is a schematic view of the formation of a web of paperboard for constructing the container;

FIG. 4 is a sectional view on a greatly enlarged scale of one of the liners used to construct the container;

FIG. 5 is a perspective of another embodiment;

FIG. 6 is a sectional view, enlarged, on the line 6—6 of FIG. 5; and

FIG. 7 is an enlarged portion of FIG. 6.

A typical container contemplated under the present invention is illustrated in FIGS. 1 and 2, identified by reference character 10. The container 10 is a six-sided carton having a top wall 12, a bottom wall 14, end walls 16 and 18, side walls 20 and 22 (double thickness, folded) and a closure flap 23 with tuck-in ears 24 and 25.

The carton or box 10 is for illustrative purposes only. The container in actual practice will vary considerably in dimensions, depending upon the electronic device to be encapsulated and protected by the carbon black circumvalate to be described hereinafter. I preferably rely on a corrugated construction of E-flute or equivalent strength because this form is easy to manufacture and has excellent physical strength. For a stronger box, B-flute, C-flute and double-wall thicknesses may be used. However, the carton could as well be constructed from so-called chip-board of suitable strength, or it could be built up from an appropriate number of thicknesses of paper laminae such as double wall, as long as there is a metal shield for protecting the device from electromagnetic interference or radio frequency interference and as long as there is a layer of conductive carbon black (or equivalent particulate conductor) safeguarding the devices against a discharge of static electricity and affording effective contact with the metal liner as will be explained.

Referring to FIG. 3, a paperboard web 30 is formed in the usual fashion from an intermediate corrugated paperboard flute 32 sandwiched between a pair of opposed paperboard liners 34 and 36, adhesively joined in the usual manner constituting no part of the present invention. The liners are supplied from large rolls 34R and 36R.

The opposed planar surfaces of the two liners 34 and 36 are coated with conductive carbon black dispersed in a suitable varnish, such as employed in a printer's ink. The carbon black dispersion may be applied by being roller-coated by opposed rollers 42 and 44. The coating, an emulsion composed of carbon black and the suitable vehicle, such as the printer's ink varnish, may also, alternatively, be applied to the liners 34 and 36 before the liners are shipped as rolls. Thus the liner material may be coated with carbon black before being joined to the corrugated filler 32, rather than afterwards as

shown in FIG. 3. This is a matter of economics and manufacturing capability.

The preferred conductive particles are VULCAN XC-72LR conductive carbon black supplied by Cabot Corporation: 98.5% by weight fixed carbon (1.5% volatiles), 19 millimicrons mean diameter, log volume resistivity (Ohms-cm) in the range of about 2.3–6. This feature of the present invention, in practice, is the same as disclosed in my aforesaid patents.

After the paperboard web has been constructed, in whatever form, whether corrugated, chip board, paper lamination or otherwise, of the preferred strength for physical protection of the devices contained therein, the web is then employed as a source of the carton blank, FIG. 2. The blank is then die-cut along a continuous perimeter edge as **48** and is scored along the fold lines as **50**. When separated from the web, the carton blank may be shipped to the user in the flat state or it may be erected, depending upon different modes of production, shipment and use.

In accordance with the present invention, and again in the instance of a corrugated box, one of the liners **34** and **36** (or both of them, if one wants to go that far) is employed as a support for the metal foil shield. This is shown on a greatly enlarged scale in FIG. 4 without attempt to show relative dimensions. In FIG. 4 it is assumed the liner **36** is to be employed as the foil support. Thus, as part of the manufacture of the liner **36**, a thin metal foil **60** is cemented or otherwise bonded between thin sheets of paper **62**. The exposed sheet of paper **62** is the surface that will be coated with a carbon black layer **64** by roller **44**, but again the liner **36** with carbon black layer **64** may be manufactured beforehand, rolled and shipped to take the place of the roll **36R**, FIG. 3. Therefore, FIG. 4 may be considered a fragment of a longitudinal section of web **30**. In any event, when the blank, FIG. 2, is die-cut and scored, the carton blank to be separated will be characterized by continuous areas of conductive carbon black with a metal foil of continuous area sandwiched therebetween.

The foil has a thickness of the order of 0.0001 of an inch, and may be more or less. Aluminum is preferred but foils of iron and other metals are also available as a substitute. The paper support **62** is also thin, and in fact is sufficiently thin that when humidity is high there is effective conductivity contact between the metal foil **60** and the carbon black coating **64** which necessarily impregnates and penetrates to some extent at least a portion of the liner sheet to which it is applied. However, as will be explained below, there is even more assurance the foil will be in effective contact with the carbon black.

As noted above, the erected and folded carton may be of almost any geometry. It may be of one panel thickness such as shown in my aforesaid patents, or it may be of double-wall thickness, especially at the sides, which is the form of construction here illustrated.

Stippling in FIGS. 1 and 2 indicates the carbon black continuum surfaces.

There is to be electrically conductive contact between the carbon black on the inside and the carbon black on the outside of the carton, and this may be readily achieved by virtue of either double-wall folds or ears on the closure flap, with carbon black on an inside surface in contact with the carbon black extending to an outside surface of the folded container. Indeed, when the ears **24** and **25** are tucked into the sidewall fold slots as **20S**, FIG. 1, there are four conductive carbon surfaces in contact, whereby the circumvalate trap for static electricity is in reality a continuum from the inside to the outside container so that any static discharge may be conducted to ground from either the inside or the outside of the container.

The metal foil shield safeguards the contained device against electromagnetic interference and radio frequency interferences. These interferences in reality are, of course, fields capable of inducing a current should the device within the container be moved within the field. The shield also safeguards the device against electrical overstress by the very presence of the field itself in a static state, regardless of any current induced. However, the shield itself is a conductor capable of supporting an induced current but this current, if created, will be drained to the conductive carbon black layer on the outside due to its being in effective contact with the carbon black layer supported on the inner liner of the corrugated blank from which the container is erected. Also, and again because the carbon black layers are in contact with one another, there is no chance of an electrostatic discharge, from whatever source, reaching the contained device which, as noted above, can be overstressed and damaged by voltages as low as five to ten volts, if not lower.

There are two ways such draining of the current or charge can take place. First, because the paper layers **62** are quite thin there will invariably be some spot, a spot at least, where the carbon black is in effective contact with the foil, especially when humidity is high because the paper itself then becomes a conductor. But more importantly, when the carton is constructed there will be one or more folds presenting a bare edge of the foil in direct contact with a carbon black surface as will now be explained in connection with FIGS. 4–6.

The container **70** shown in FIG. 4 is intended to illustrate that the invention may be applied to a five-walled container constituting an assembly tray or storage bin for electronic parts subject to damage by the same phenomena discussed above.

The container **70** will be obtained in the same manner as explained in connection with FIGS. 2 and 3 except when the carton blank is scored and die-cut there will be no provision for a top or lid **12**, front closure flap **23**, nor tuck-in ears **24** and **25**. The parts deemed the same are denoted by the same reference characters employed in FIGS. 1 and 2.

FIG. 5 is an enlarged section taken on the line **5**—**5** at one side of the container **70**, FIG. 4, and FIG. 6 is an enlargement of a portion of FIG. 5.

Referring now to FIG. 6, the bottom wall **14** is shown on an enlarged scale compared to FIG. 5 and so is the fold-over end wall **20**. This fold-over, as will be evident in FIG. 5, constitutes a strengthening flap at the end, and the free die-cut edge **20E** is in contact with the inside surface of the bottom wall. This means the die-cut edge **60E** of the metal foil **60** will be in effective electrical contact with the carbon black layer **64** at the inside of the container, such contact assuring that any charge or current induced on or in the foil will be drained to the carbon black surface **64** and from thence to the carbon black layer **34** on the outside surface of the container, where it may be drained to ground. The end wall **18**, FIG. 7, will also present a die-cut edge of the contained foil to carbon black surface **64**.

Because the carton blank is die-cut and because the carbon black surfaces are continuous, and because the interposed metal foil is continuous, the die-cut edges

inherently expose an edge of the metal foil. Therefore what has been been explained in connection with the tray form of the invention, FIG. 4, where the die-cut edge of the metal foil 60 effectively accounts for draining any induced charge on the foil applies equally well to the form of the container as shown in FIG. 1. Thus it can be readily imagined, FIG. 1, that when the end flaps or ears 24 and 25 are tucked into their respective slots as 20S the die-cut edges of the metal foil, at the exposed edges of the ears 24 and 25, will be in effective contact with the conductive carbon black layer at the inside surface of the carton; this applies equally well to the end wall 18 and fold-over flaps 20 and 22 of FIG. 1.

Hence while I have illustrated and described preferred embodiments of my invention, it is to be understood that these are capable of variation, modification and other equivalent practice.

I claim:

1. A six-walled paperboard container for protecting electronic goods contained therein from damage due to electrostatic discharge, due to electromagnetic field interference or due to interference from a radio frequency field, constructed from a flat paperboard blank, said paperboard blank on its opposed planar surfaces presenting continuous layers of conductive carbon black and of which at least one carbon black layer is in effective contact with a metallic foil therebeneath and united to the blank so that any electric charge on the metal foil will drain to said one carbon black layer, said blank being so folded as to present five walls and a closure wall joined thereto collectively presenting said six-walled container defining a cavity for the electronic goods, the closure wall when closed having at least one flap with its carbon black layer in contact with the carbon black layer on an interior surface of the container so that any current induced by either field on the foil will be conducted to the exterior of the container via said flap contact and from thence may be drained to ground.

2. A container according to claim 1 characterized by an intermediate sheet of corrugated paperboard sandwiched between inner and outer paperboard liner sheets, the outside surfaces of the liner sheets being coated with conductive carbon black dispersed in a varnish, and the metal foil being positioned between the liner sheets.

3. A container according to claim 2 in which the metal foil is in effective contact with the liner at the inside of the container.

4. A six-walled paperboard container for protecting electronic goods contained therein from damage due to electrostatic discharge, due to an electromagnetic field or due to a radio frequency field, constructed from a paperboard blank, said paperboard blank presenting a continuous layer of conductive carbon black which is in effective contact with a metallic foil united to the blank so that any electric charge on the metal foil will bleed to said carbon black layer, said blank being so folded as to afford five walls and a closure wall joined thereto collectively presenting said six-walled container defining a cavity for the electronic goods with the carbon black layer extended from the inside to the outside of the container and with a carbon black surface on the outside in contact with a carbon black surface on the inside, whereby any current induced on the foil will be conducted to the exterior of the container via said contact so the induced current may be drained to ground.

5. A container according to claim 4 in which the paperboard container is constructed of corrugated paperboard characterized by an intermediate sheet of corrugated paperboard sandwiched between inner and outer paperboard liner sheets, the liner sheets bearing conductive carbon black dispersed in a varnish, and the metal foil being positioned between the liner sheets.

6. A container according to claim 5 in which the metal foil is in effective contact with the liner at the inside of the container.

7. A paperboard container having at least five walls defining an enclosure for protecting electronic goods contained therein from damage due to electrostatic discharge, due to electromagnetic field interference or due to interference from a radio frequency field, constructed from a flat paperboard blank, said paperboard blank on its opposed planar surfaces presenting continuous layers of conductive carbon black positioned adjacent a metallic foil and so united to the blank that any electric charge on the metal foil will drain to said carbon black layer, said blank being so folded as to present at least five walls collectively defining a cavity for the electronic goods, at least one of said walls including a die-cut edge exposing an edge of the metal foil in contact with a carbon black layer on an interior surface of the container so that any current induced by either field on the foil will be conducted to the exterior of the container via said metal edge-to-carbon black contact and from thence may be drained to ground.

8. A container according to claim 7 characterized by an intermediate sheet of corrugated paperboard sandwiched between inner and outer paperboard liner sheets, the outside surfaces of the liner sheets being coated with conductive carbon black dispersed in a varnish, and the metal foil being positioned between the liner sheets.

9. A container according to claim 8 in which the metal foil lies adjacent the carbon black layer associated with the liner at the inside of the container.

10. A paperboard container for protecting electronic goods contained therein from damage due to electrostatic discharge, due to an electromagnetic field or due to a radio frequency field, die cut from a paperboard blank, said paperboard blank presenting a continuous layer of conductive carbon black which is positioned adjacent a metallic foil united to the blank to enable any electric charge on the metal foil to be bled to said carbon black layer, said blank being so folded as to afford a container having at least five walls collectively defining a cavity for the electronic goods with the carbon black layer on the inside in contact with a carbon black surface on the outside, and said container being further so folded as to present at least one flap having an edge of metal foil in contact with a carbon black surface of the inside of the container, whereby any current induced on the foil will be conducted to the exterior of the container via said contact so the induced current may be drained to ground.

11. A container according to claim 10 in which the paperboard container is constructed of corrugated paperboard characterized by an intermediate sheet of corrugated paperboard sandwiched between inner and outer paperboard liner sheets, the liner sheets bearing conductive carbon black dispersed in a varnish, and the metal foil being positioned between the liner sheets.

12. A container according to claim 11 in which the metal foil is in effective contact with the liner at the inside of the container.

* * * * *

United States Patent [19]
Schertler

[11] **Patent Number: 4,461,665**
[45] **Date of Patent: Jul. 24, 1984**

[54] **SHEET TYPE COMPOSITE MATERIAL AND METHOD AND APPARATUS FOR MANUFACTURING THE SAME**

[76] Inventor: **Manfred K. Schertler**, Eulatalstrasse 31, 8858 Neuburg, Fed. Rep. of Germany

[21] Appl. No.: **394,494**

[22] Filed: **Jul. 2, 1982**

[30] **Foreign Application Priority Data**

Jul. 8, 1981 [DE] Fed. Rep. of Germany 3126948
Apr. 21, 1982 [DE] Fed. Rep. of Germany 3214821

[51] **Int. Cl.**^{3} **B32B 31/04**; B32B 31/14; B32B 3/28

[52] **U.S. Cl.** **156/210**; 156/269; 156/292; 156/322; 156/324; 156/330.9; 428/182

[58] **Field of Search** 428/182, 184, 185, 186, 428/595, 603, 604; 156/210, 463, 269, 292, 311, 322, 324, 330.9

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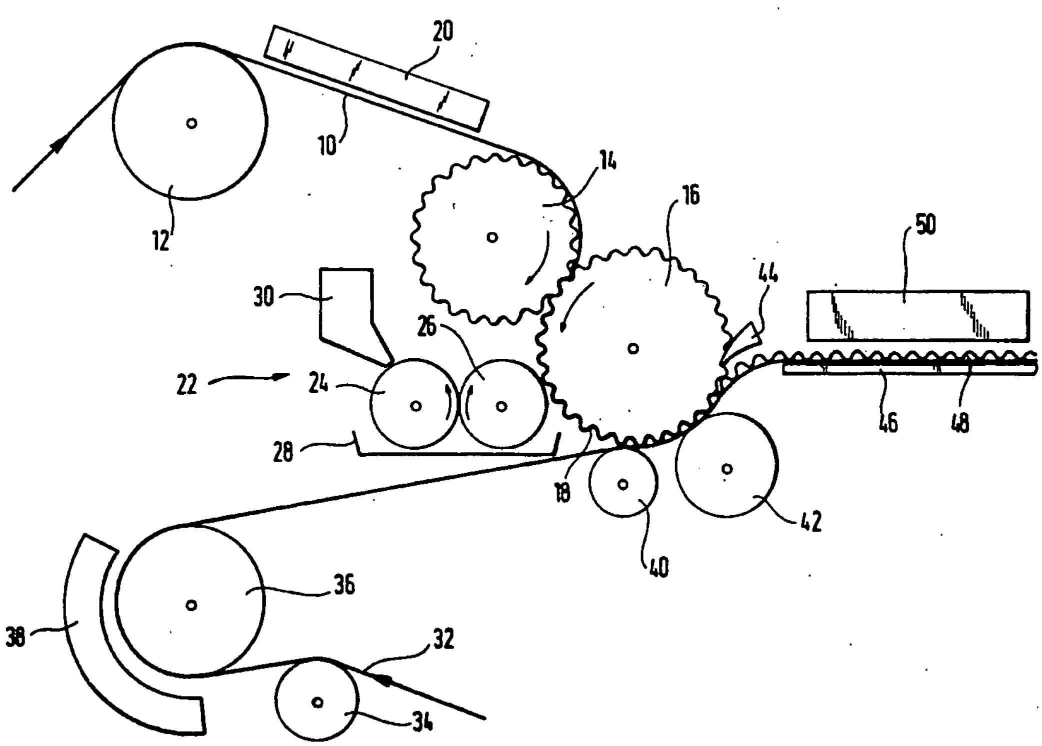
Attorney, Agent, or Firm—McCormick, Paulding & Huber

[57] **ABSTRACT**

The invention concerns a sheet like composite material which consists of a uniformly corrugated web and at least one flat web connected to it by welding, soldering or gluing wherein at least one of the webs is made of metal, and a method and apparatus for continuous manufacture of said composite material.

7 Claims, 7 Drawing Figures



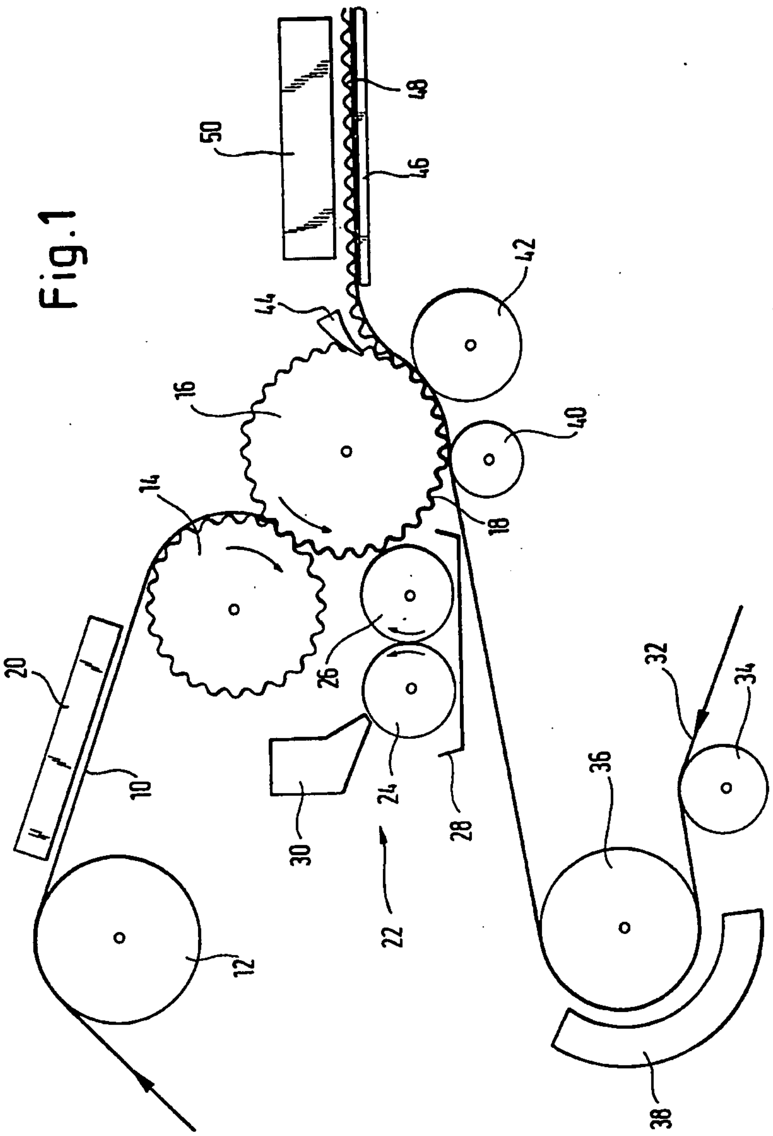


Fig.1

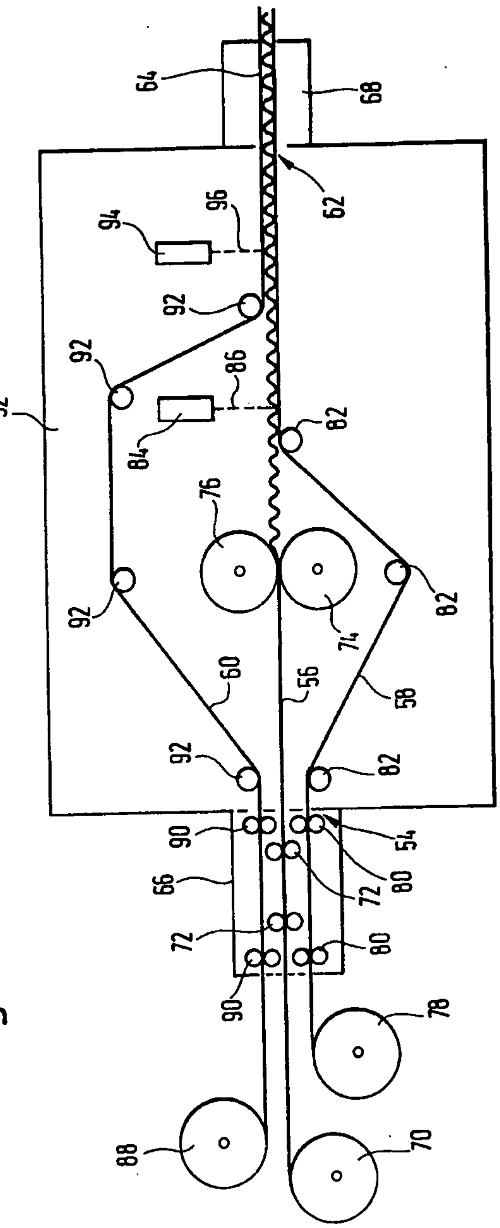


Fig. 2

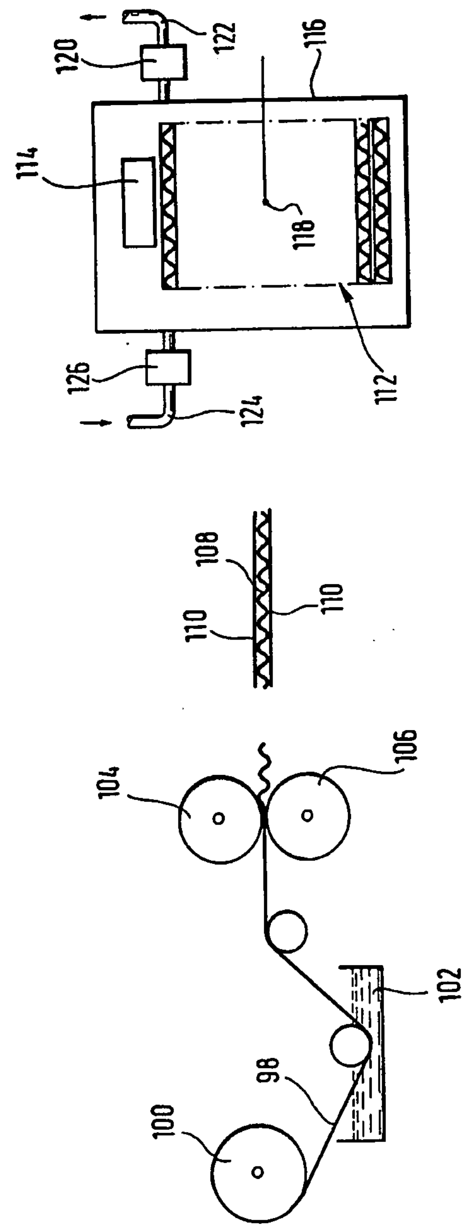


Fig.3

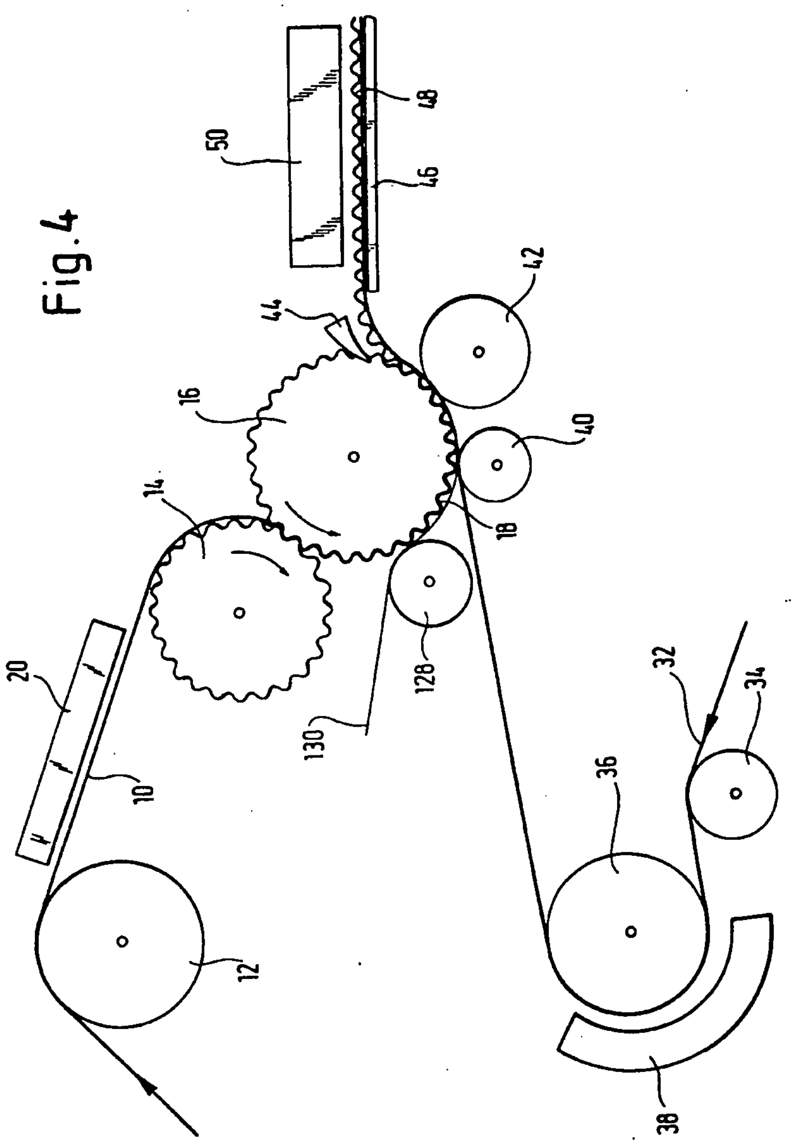


Fig. 4

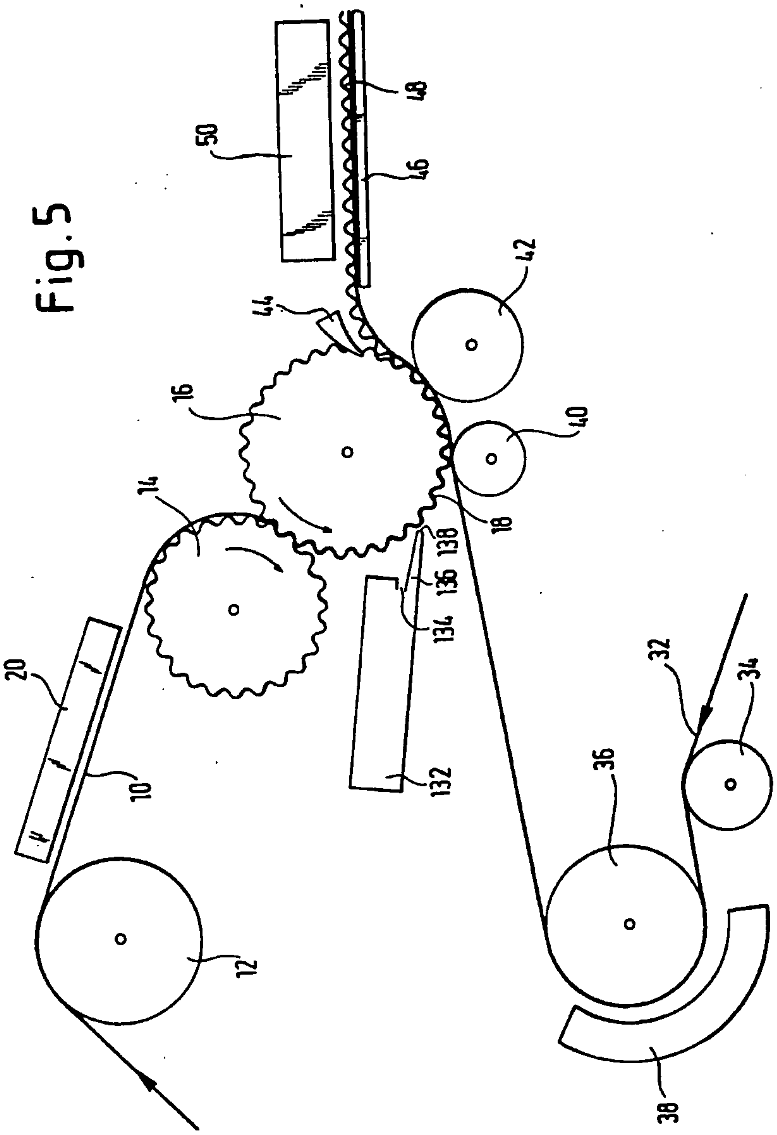


Fig. 5

Fig.6

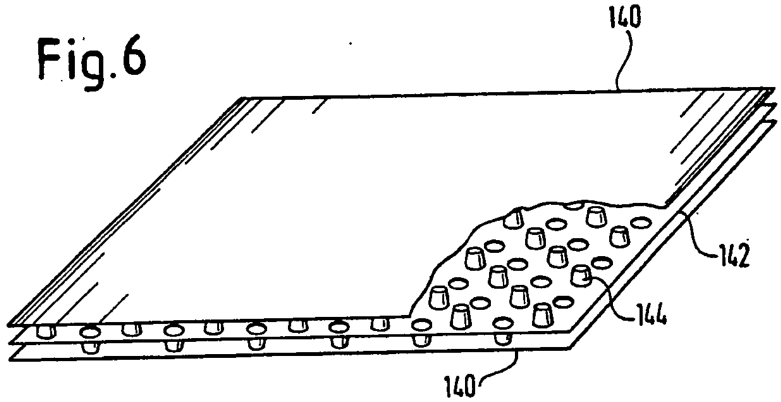
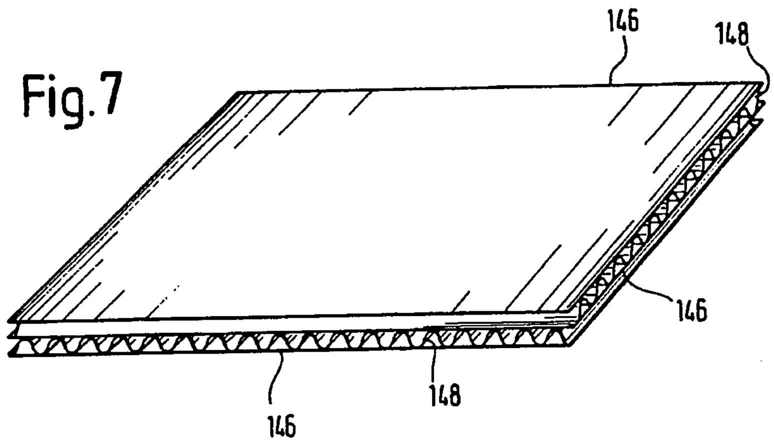


Fig.7



SHEET TYPE COMPOSITE MATERIAL AND METHOD AND APPARATUS FOR MANUFACTURING THE SAME

The invention concerns a sheet type composite material, as well as a method and an apparatus for manufacturing such composite material, that consists of at least one profiled material web and at least one flat material web which webs are connected to one another in the vicinity of their coengaging surface portions.

A composite material of this kind in which the profiled web is corrugated and the webs consist of paper has been known for a long time as corrugated cardboard. The strength of such corrugated cardboard is however relatively limited. For example, if a piece of corrugated cardboard of a few millimeters gauge is loaded with a compressive force acting in its plane the piece will buckle under a relatively small force. Therefore, corrugated cardboard, at least that of relatively small wall thickness, is used primarily for packing and decoration purposes, and not for the manufacture of constructions which are exposed to relatively high forces. Moreover, corrugated cardboard is sensitive to dampness and is combustible, to name only two disadvantages, which forclose its use for many construction purposes.

The object of the invention is to provide a composite material of the foregoing kind that possesses a high mechanical strength and a good resistance to weather with a small raw material requirement and a low weight.

This object is achieved in accordance with the invention by at least one of the material webs being made of metal. Even a composite material in which only one of the material webs is made of metal while the other web is or the other webs are made of paper possesses a considerably higher strength and weather resistance in comparison to customary corrugated cardboard that it can be used for many purposes where corrugated cardboard is not usable.

Preferably all of the material webs consists of metal. The profiled material webs can be uniformly corrugated or provided with a nubby profile on both sides. In the following description a corrugated metal web is referred to, however the invention is not limited to such a web. The material webs can be glued to one another or, so far as the material webs all consist of metal, can also be connected to one another by welding or soldering.

The composite material made of metal webs possesses a strength which is comparable with that of metal sheets of relatively larger gauge. Therefore, to produce a composite material having a similar strength with respect to mechanical stress the metal webs used in the manufacture are required to have only a very small gauge thereby requiring an essentially smaller quantity of raw material and therefore also achieving an essentially lower weight in comparison to a massive sheet of similar size or strength. If the corrugated web is connected only at one side with one flat web a material is produced that exhibits a high strength under loading in the longitudinal direction of the corrugations but which however is easily formed about an axis running parallel to the longitudinal direction of the corrugations.

The material of the invention can be made in a continuous manner whereby one sheet metal web is pulled from a first supply roll and corrugated between two interengaging profiled rolls and whereby at least one flat sheet metal web is pulled from a second supply roll and is continually conducted into engagement and connected with the corrugated sheet metal web.

In the case of a glued connection between the sheet metal webs it is advantageous to burn off the faces to be glued to one another before the gluing step, preferably through the use of a gas flame, in order to remove residual oil from the rolls and to prepare the gluing surfaces for the applied glue. Especially in the case of using a hot melt material as the glue a better adhesion of the glue to the sheet metal webs is achieved in this manner. Subsequent to the burning off step the sheet metal webs are brushed with rotating metal brushes shifting in the axial direction in order to clean the sheet metal webs of residue from the burning off process and to roughen the surfaces of the webs to obtain a better adhesion of the glue.

In the case of using a hot melt material as the glue the corrugated sheet metal web is preferably profiled by means of heated profiling rolls. The application of the glue advantageously follows in such a way that the previously melted glue is applied in the form of a film to oppositely running driven heated gluing rolls by means of an elongated slot nozzle, one of which gluing rolls is brought into engagement with the corrugated sheet metal web. The gluing rolls are heated, according to the type of hot melt material used, to about 180° to 260° C. The wave crests of the corrugated sheet metal web take from the continuous film on the gluing roll only about twenty percent of the glue. The removed glue is constantly replenished by means of the elongated slot nozzle and the flow through the nozzle is so controlled that only the removed glue is made up for to thereby inhibit charring of the hot melt material on the gluing rolls.

In order to make certain that a uniform thin supply of glue results only on the crests of the corrugations of the sheet metal the gluing rolls are brought into engagement with a portion of the corrugated sheet metal web which is still in engagement with one of the profiling rolls. Thus the corrugated sheet metal web is held in a definite position relative to the gluing roll.

The flat sheet metal web is preferably preheated, pressed against the corrugated sheet metal web provided with glue and subsequently cooled in such a manner that the pressing together and the cooling occurs over a section of the corrugated sheet metal web which is still received on one of the profiling rolls. For one thing, in proceeding in this manner a backup roll can be used for pressing the flat sheet metal web to the corrugated sheet metal web without, even at high pressing pressures, either deforming or distorting the corrugated sheet metal web. For another thing, through this preferred sudden cooling of the flat or smooth sheet metal web before the loosening of the corrugated web from the profiling or riffling roll it is assured that the hot melt material is hardened to such a degree that a secure adhesion is obtained which prevents the two sheet metal webs from being displaced from one another as the corrugated sheet metal web is pulled from the profiling roll.

The cooling of the flat sheet metal web takes place preferably by means of a cooled contact roll rolling on the free surface of that web. Because of the insulating air cushions in the canals enclosed by the corrugations and the low heat conduction in the corrugated sheet metal web itself the temperature of the corrugated sheet metal web remains high enough in the vicinity of its free

wave crests that they can still be connected to another flat sheet metal web through the use of a hot melt material. This takes place for example in such a way that the composite material consisting of the corrugated sheet metal web and one flat sheet metal web is continually moved over a flat supporting surface, that after the application of glue to the free wave crests of the corrugated sheet metal web, for example in the above described manner, a second heated sheet metal web is continually moved to the composite material and pressed against it, and that the composite material consisting of the three sheet metal webs is then cooled. The cooling can be accomplished in such a manner that on one side of the resulting material web air is withdrawn from the canals formed by the corrugated sheet metal web and on the other side of the material web cold air is blown into the canals. The resulting composite material can then be divided into plates and stacked.

If the corrugated sheet metal web is connected to only one flat sheet metal web the resulting material can be rolled up on a roll. In this case the material taken from the profiling roll can be additionally cooled to achieve a quicker hardening of the hot melt material.

Preferably the material webs are glued to one another using a polyamide glue material which effects a very permanent connection between the material webs with a small quantity of glue.

The glue material may be applied in a very simple manner by means of a polyamide foil which is inserted between the material webs and heated to the melting temperature of the polyamide material. Of course, this method of application uses more polyamide material than is really necessary since the flat material web and the corrugated material web only engage one another over small portions of their surfaces.

An essentially smaller usage of polyamide glue may be achieved by extruding the polyamide glue near the location past which the two material webs are driven and by having the glue wiped onto the wave crests of the corrugated material web from a lip extending along the extruder opening. The speed of extrusion from the extruder is so regulated that each time a wave crest moves past the lip of the extruder opening exactly the amount of glue is wiped from the lip as is necessary for the gluing of the material webs together along the wave crest.

The previously described type of gluing is particularly well suited for a composite material that consists of at least one metal web and one or more webs of paper. Thereby, for example, a composite material like a kind of corrugated cardboard can be manufactured in which at least one of the outer flat material webs consists of a thin metallic foil. This results in a material which is relatively moisture-resistant in comparison to customary cardboard.

The use of a polyamide foil offers also the possibility to make an initial material which then can be used for manufacturing objects of different forms. The initial material consists of a corrugated material web and a flat material web glued to the corrugated web wherein the free side of the corrugated web is coated with a polyamide foil. This material for example, can be wrapped around a thin walled tube with the polyamide foil carrying side of the corrugated material web adjacent the tube and can be glued to the tube by heating so that in this way a tube formed of composite material can be produced.

The sheet metal webs can also be connected to one another through the use of a two component glue, for example an epoxy glue or a phenol glue. In this case the sheet metal webs are also burned off and brushed in the above described way. The glue application takes place in such way that the flat sheet metal web is preheated and provided with a film of hardener and that subsequently the second glue component is applied slightly warmed by means of a glue applying apparatus of the above described kind. Heat assisted this second glue component reacts immediately with the hardener film and brings about sufficient initial adhesion to hold the sheet material webs to one another. The corrugated sheet metal web in this process is profiled in the same manner as described above. In place of the above described cooling roll a heated roll is used to inhibit the cooling of the sheet metal webs and to accelerate the hardening of the glue material.

In the case of manufacturing a three layered composite material the third material web is made available in the same way as just described and is guided to a composite material web driven over a flat supporting surface.

The cut plates are driven between heating devices, for example infrared heaters, and heated from above and below to about 260° C. Thereafter they are stored in an insulated chamber until entirely hardened. Because of the good insulating properties of the air enclosed in the profiles the cooling of the stack proceeds only very slowly.

In order to obtain a composite material that is resistant to both high temperature and to the effects of chemical substances it is advantageous that the sheet metal webs are soldered to one another. This can for example be achieved in such way that the sheet metal web to be profiled and/or the flat sheet metal web is coated with solder on the face which is to engage the other web, that after the profiling and the cutting to length of the profiled sheet metal web a piece of the same as well as at least one piece of one flat sheet metal web are laid upon one another, and that the so laid up web pieces are then heated in a high vacuum to the melting temperature of the solder and subsequently cooled. Preferably the cooling is achieved through the use of a cold protective gas. For economy in working, the sheet metal pieces to be connected to one another are advantageously stacked in a plurality of layups upon one another so that the entire stack can be heated in an evacuatable container or room by means of radiation heat. The temperature can be supervised by a temperature sensor inserted into the center of the stack.

The sheet metal webs can also be connected to one another by welding. Preferably the welding is achieved by means of an electron beam welder. Such a method allows a continuous processing of the inventive composite material. Preferably the corrugated sheet metal web is so welded with the first flat sheet metal web that the electron beam engages the corrugated sheet metal web in its wave troughs or valleys. Thereby welding can be accomplished without producing visible welding tracks on the outer side of the flat sheet metal web. In the welding of the second flat sheet metal web these welding tracks cannot be avoid- ed.

The sheet metal webs can also be welded to one another in other ways, for example through projection welding or through the use of a laser beam.

A device for manufacturing the inventive composite material through electron beam welding includes, in

accordance with the invention, a high vacuum chamber with an input opening for the sheet metal webs to be connected to one another and an outlet opening for the composite material, an input and an output lock, profiling rolls arranged in the high vacuum chamber for profiling the corrugated sheet metal web as well as guide rolls for guiding together the sheet metal webs to be joined and at least one electron beam welding device the electron beam of which is preferably controlled in accordance with the continuous speed of the material webs so that it is not only deflectable along the length of the corrugations but is also deflectable transversely of the corrugations. The locks are advantageously divided into several chambers so that the vacuum is increased stepwise from chamber to chamber. Also, an individual input lock can be provided for each of the sheet metal webs.

In order to avoid the sealing problems associated with locks, the supply rolls for the metal webs can also be located inside of the high vacuum chamber. The high vacuum chamber must further be equipped with a shield against the x-rays emitted during the electron welding.

Further features and advantages of the invention will be apparent from the following description which in association with the accompanying figures explain the invention by means of exemplary embodiments.

FIG. 1 is a schematic side view of an apparatus for manufacturing a composite material by gluing together a corrugated sheet metal web and a flat sheet metal web.

FIG. 2 is a schematic representation of a device for manufacturing a composite material of three sheet metal webs, which are connected to one another by electron beam welding.

FIG. 3 is a schematic representation of the steps in a process for soldering the sheet metal webs.

FIG. 4 is a view similar to FIG. 1 but showing gluing by means of a polyamide foil.

FIG. 5 is a view similar to FIG. 1 but showing gluing by means of an extruded polyamide material.

FIG. 6 is a perspective view of a section of composite material using a material web provided with a nubby profile.

FIG. 7 is a perspective view of a composite material using two corrugated material webs.

Referring to the apparatus shown in FIG. 1, a first sheet metal web **10** is pulled from a supply roll (not shown) over a training roller **12** and fed to the nip of two profiling rolls **14** and **16** which have corrugated profiles with uniform waves which extend parallel to their axes and which engage one another like gears. By its passage through the nip of the rolls the sheet metal web **10** receives a corresponding corrugated profile with wave crests running perpendicular to its longitudinal direction.

The profiling or fluting rolls **14** and **16** as well as the training roll **12** may be heatable ones. Additionally or alternatively thererto a heating apparatus **20** is provided before the profiling roll **14** to heat the sheet metal web **10** by means of heated air or infrared rays.

By means of a gluing apparatus indicated generally at **22** a hot melt material is applied to wave crests of the profiled sheet metal web **10** which still lie on the profiling roll **16**. The glue application apparatus includes two heated gluing rolls **24** and **26** which rotate above a glue collecting container **28**. A thin film of premelted hot melt material is applied to the gluing roll **24** by means of an elongated slot nozzle **30**. The hot melt mass is transmitted from the gluing roll **24** to the gluing roll **26** on which a thinner film of glue is formed. The wave crests of the profiled metal web **10** which tangentially come into engagement with the gluing roll **26** take off about twenty percent of the glue film so that a small line of glue remains on the wave crests of the sheet metal web. The glue which is used in this manner is supplemented by the elongated slot nozzle. By a controller for the elongated slot nozzle flow through it is controlled so that the flow is only as much as actually required in order to avoid the accumulation and charring of glue material on the heated glue rolls **24** and **26**.

A second sheet metal web **32** is pulled from another supply roll (not shown) over training rolls **34** and **36**. The training rolls and **34** and **36** may be heated if desired. Alternatively or additionally a heating apparatus **38** is provided and arranged coaxial to the training roll **36**. The sheet metal web **32** after leaving the training roll **36** is pressed against a portion of the corrugated sheet metal web **10** which still lies in the profiling roll **16** by means of a pressure roll **40**. Behind the pressure roll **40**, in the transport direction, is a cooling roll **42** which engages the outer side of the flat sheet metal web **32** and cools it off in a sudden or shock-like manner, so that the hot melt material at the glue locations between the flat sheet metal web and the wave crests of the corrugated sheet metal web are hardened to such an extent that the two sheet metal webs **10** and **32** which are connected to one another are adequately firmly adhered to one another. The connected sheet metal webs can now be pulled from the profiling roll **16** by means of the schematically represented finger **44** and pulled onto a table or another flat supporting surface **46**. Here the resulting composite material **48** is entirely cooled by means of a cooling apparatus **50** which may be of a type including a means such as a heat pump enabling the removed heat to be used again for heating the sheet metal webs **10** and **32**.

The resulting composite material web can be bent about an axis running perpendicular to its longitudinal direction and therefore can be rolled up onto a roll. However, if a composite material is to be made in which the corrugated sheet metal web has flat sheet metal webs on both of its sides the cooling apparatus **50** is omitted. Instead of this at its place a further glue application apparatus is arranged in order to apply glue to the still warm corrugated sheet metal web. Further, a third sheet metal web is conducted to the corrugated sheet metal web and by means of a pressure roll (not shown) is pressed against the composite material **48** on the table **46**. The cooling of the resulting three-layer composite material then takes place by blowing cool air through the hollow spaces or canals inside the composite material. Here also the removed heat can be used again.

FIG. 2 shows in a schematic way an apparatus for manufacturing a three-layer composite material wherein the three sheet metal webs are connected to one another by electron beam welding. The device includes a high vacuum chamber **52** with an entrance **54** for the input of three sheet metal webs **56**, **58** and **60** and with an outlet **62** for the exit of the finished composite material **64**. At the entrance and the outlet of the high vacuum chamber **52** are vacuum locks **66** and **68**, respectively.

The middle sheet metal web **56** is pulled from a supply roll **70** over guide rolls **72** into the vacuum lock **66** and lead to profiling rolls **74** and **76** which are profiled

in the same way as the profiling rolls **14** and **16** of FIG. **1** and give the sheet metal web **56** a corrugated profile.

The bottom sheet metal web **58** is pulled from a supply roll **78** and by means of the guide rolls **80** in the vacuum lock **66** as well as the guide rolls **82** in the high vacuum chamber **52** are driven into engagement with the undersurface of the corrugated sheet metal web **56**. An electron beam welding apparatus **84** is arranged above the corrugated sheet metal web **56** and welds the sheet metal web **56** and the sheet metal web **58** to one another, the electron beam **86** being so controlled that the resulting weld joint runs along one of the valleys of the sheet metal web **56**. In this way no welding tracks appear on the free outer surface of the sheet metal web **58**.

The third sheet metal web **60** is driven from a supply roll **88** over guide rolls **90** in the vacuum lock **66** and guide rolls **92** in the high vacuum chamber **58** to the corrugated sheet metal web **56** at a point behind the electron beam welding machine **84** in the transport direction, and from above this machine, and is welded to the corrugated sheet metal web by means of another electron beam welding apparatus **94**. The electron beam **96** is so controlled from above the sheet metal web that the sheet metal web **60** and the corrugated sheet metal web **56** are welded to one another along the lengths of the crests of the corrugations. The resulting composite material made of the three sheet metal webs welded to one another leaves the apparatus through the outlet **62** and the outlet lock **68**. Thereafter it can for example be cut into plates of desired size with the help of metal saws or the like.

The locks **66** and **68** are represented only as simple blocks. In practice, these locks in general as a rule are divided into several chambers successively connected to one another in which a gradual transition from atmospheric pressure to the pressure of the chamber **52** is obtained.

Instead of only one input lock **66** there can also be one input lock for each of the sheet metal webs. Further, the supply rolls **70**, **78** and **88** could be arranged inside the high vacuum chamber **52** to avoid the problems of introducing the material into the high vacuum chamber **52** by means of locks.

FIG. **3** shows in schematic form the manufacture of composite material plates in which the sheet metal pieces are soldered to one another. The sheet metal web **98**, which becomes the profiled middle web, is pulled from a supply roll **100** and subsequently runs through a solder bath **102** in which it is provided with a solder coat on both of its sides. Thereafter the web **98** is profiled between profiling rolls **104** and **106** and cut to length. A piece **108** of the profiled sheet metal web and two flat sheet metal web pieces **110** are laid upon one another as shown and are stacked with similar layups each also made of three sheet metal pieces. The stack **112** so made is loaded with a weight **114** and heated in a pressure chamber **116** under high vacuum by means of a heat radiation source (not shown) to the melting temperature of the solder. The temperature can be supervised by a temperature sensor **118** located in the center of the stack **112**. The creation of the vacuum in the pressure chamber **116** is achieved by means of a vacuum pump (not shown), connected to a pipe **122** which can be shut off by a valve **120**. Upon the melting of the solder the three sheet metal pieces of each layup become joined together, whereupon a cool protective gas is introduced into the pressure chamber **116** through a further pipe **124**, which may be shut off through a valve **126**, to cool off the sheet metal webs and the solder. Thereafter the finished composite material plates may be taken from the pressure chamber. In this way composite material plates with for example a length of twelve meters and a width of 1.3 meters can be manufactured quickly and easily.

A multitude of applications can be offered for the material manufactured in the previously described way. In automobile construction the material of the invention allows a substantial saving of material and weight to be achieved without, as for example in the case of using plastic, compromising strength and/or safety.

In the manufacture of pipes or ducts for ventilation and air conditioning equipment or installations it becomes for example possible to cut the material on site and to fabricate the pipes and ducts at the construction site whereas previously the pipe and duct sections had to be preworked in a workshop because the sheet metal previously used had to be formed to give the pipe or duct parts necessary rigidity. Moreover, the material of the invention has a high heat insulation effect because of the air entrapped in the corrugation canals.

The apparatus shown in FIG. **4** differs from that of FIG. **1** only with regard to the apparatus for applying the glue material. Therefore, similar parts have been given similar reference numbers and are not explained again.

Instead of the glue applying apparatus generally indicated at **22** a single roll **128** is provided which guides a polyamide foil **130** from a supply roll (not shown) into place between the corrugated web **18** and the flat web **32**. The polyamide material may be a copolyamide with a working temperature of about 260.

In FIG. **5** the parts which are the same as ones in FIG. **1** have been given the same reference numbers and are not further explained. Instead of the glue applying apparatus **22** according to FIG. **1** an extruder **132** (shown only schematically) is provided, through the extrusion slot **134** of which the polyamide glue material is extruded. The extruder **132** has a lip **136** over which the extruded glue flows. The gap between the forward edge **138** of the lip and the wave crests of the material web **18** is of such size that the wave crests which move past the forward edge **138** of the lip **136** wipe the flowing material from the lip. The gap measures about 1/10 mm. The speed of extrusion of material from the extruder is controlled in dependence on the speed of the corrugated material web **18** running past the lip **136** so that for each wave crest only so much material flows over the lip **136** as is necessary to reliably glue the corrugated web **18** along the wave crest to the flat web **32**. It is also to be emphasized that the extruder **132** naturally could also be arranged vertically to facilitate the flow of the extruded material over the free edge of the lip **136**.

FIG. **6** shows in a perspective schematic view a section of a composite material consisting of two flat material webs **140** and an intermediate profiled web **142**, wherein the profiled web **142** has a nubby profile with nubs or bosses **144** on both of its sides. The nubs naturally can have any desired shape different from the illustrated one.

FIG. **7** shows finally in a perspective section a composite material suited to high loads which consists of three thin material webs **146** and two corrugated material webs **148**, each of which corrugated webs is arranged between two of the webs **146** so that their wave

directions are arranged perpendicular to one another. According to the required rigidity more than two overlying corrugated material webs can be used, in which case the wave directions of neighboring corrugated material webs cross one another. Also it is possible to lay the corrugated material webs **148** directly on one another without an intermediate flat material web **146** and to connect the corrugated material webs directly to one another.

The composite material of the invention with a total thickness of only a few millimeters and a low weight exhibits an exceptionally high strength and load bearing ability.

I claim:

1. A process for making a sheet type composite material characterized by the steps of pulling a first sheet metal web from a first supply roll and profiling it between two interengaging profiling rolls at least one of which is heated, pulling a second flat sheet metal web from a second supply roll and continuously guiding it into contact with the profiled sheet metal web, gluing said two webs to one another while they are continuously brought into contact with one another by means of a hot melt material serving as a glue material, heating said first web in advance of its reaching said profiling rolls, heating said second sheet metal web in advance of its being brought into contact with said profiled web, applying said glue to said profiled web prior to said first and second webs being brought into contact with one another, said step of binging said first and second webs into contact with one another being performed while the portion of the profiled web at which the contact takes place is still positioned on one of said profiling rolls, pressing said two sheet metal webs to one another as they are brought into contact with one another and thereafter cooling them off, said steps of pressing and cooling off being performed while the involved portion of said profiled sheet metal web is positioned on said one of said profiling rolls, after said steps of pressing and cooling said two sheet metal webs continuously driving the now joined pair of webs over a flat supporting surface, applying glue to the free profiled crests of the profiled web, continuously driving a third heated flat sheet metal web and bringing it into contact with said free profiled crests and pressing it against said now joined pair of webs, and then cooling the so-formed three layered layup and cutting it to size.

2. The process defined in claim **1** further characterized by said glue being a thermoplastic polyamide material.

3. The process defined in claim **1** further characterized by extruding said glue near the location at which said first and second sheet metal webs are brought together and wiping it from a lip extending along an extruder opening by the wave crests of said profiled web.

4. The process defined in claim **1** further characterized by applying said glue to oppositely running driven gluing rolls by means of an elongated nozzle in the form of a film, and bringing one of said gluing rolls into engagement with the wave crests of said profiled web near the location at which said two webs are brought together.

5. The process defined in claim **4** further characterized in that the glue applying roll engages a portion of the profiled web which is positioned on said one of said profiling rolls.

6. A process according to claim **1** further characterized in that the step of cooling off said first and second webs after their being brought into contact being accomplished by means of a cooled contact roll engaging the free surface of said first flat sheet metal web.

7. A process as defined in claim **1** further characterized in that the step of cooling off said three layered layup is achieved at least in part by conducting cooling air through the hollow spaces in such three layered layup.

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